EL647233199US

Apparatus and Method for an Accelerated Thumbwheel on a Communications Device

Related Application

This application claims priority to U.S. provisional application Serial No. 60/246,540 entitled "Apparatus and Method for an Accelerated Thumbwheel on a Communications Device" filed November 7, 2000. By this reference, the full disclosure, including the drawings, of U.S. provisional application Serial No. 60/246,540 is incorporated herein.

Field of Invention

The invention relates to communications devices and more specifically to user interfaces for communications devices having a manipulable mechanism used for signalling and application messaging.

Description of the Related Art

Traditional thumbwheel or roller mechanisms operating on communications devices allow a user to signal a software application by a rotation upwards or downwards. For the class of rollers that relate to the invention, rotations are discrete or digital, with a signal caused by every click of the roller rotation. Traditionally, an interrupt service routine processes those click signals and in turn signals the user's intention by placing messages in a queue. Each message in the queue is sent to applications running on a device. Traditional roller messages signal that a rotation has occurred, and the direction of rotation. Some advanced roller messages also signal the amount of rotation.

FIG. 1 illustrates a typical interrupt service routine used with a roller mechanism in a communications device. With reference to FIG. 1, step **10** waits for roller activity to occur. This usually involves an interrupt service routine being triggered due to the rotation of the roller. At step **12** the roller position is incremented in the direction of the rotation of the roller, by a constant, which is proportional to the amount of roller rotation. Step **16** places the roll message into

a queue, which is accessible to the communications device system software so that the message can be communicated to the currently running application.

Such a traditional roller implementation does not address the concern of detecting and signalling to a software application the degree of urgency with which a user imparts rotational motion upon the roller. The urgency may stem from a user's frustration that the wheel rotation is not causing an action in an application to occur fast enough. For instance, while traversing a particularly long list of contact names in an address book application, the roller rotation is used by the application to move a cursor, which in turn is used by the user in selecting a particular contact name in the list.

Summary

The present invention overcomes at least some of the drawbacks of the previous approaches by providing a way for detecting the degree of urgency with which a user imparts a rotation onto a roller. The invention also provides a way for signalling the degree of urgency with which the user imparts motion onto a roller to an application. The detection of the degree of urgency in rotation includes keeping track of state information regarding the rotation of the roller and monitors changes in roller state information over time.

Brief Description of the Drawings

In order that the invention may be more clearly understood, the preferred embodiment thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a flowchart of the prior art method for roller operations;

FIG. 2 is a block diagram depicting components used to process urgency activities;

FIG. 3 is a flowchart depicting steps used to process urgency activities;

FIG. 4 is a flowchart depicting steps used to detect roller inactivity;

FIG. 5 is a flowchart depicting steps used to detect consecutive strokes of a roller; and

FIG. 6 is a block diagram depicting components used to process urgency activities within an exemplary communications device.

Detailed Description of Examples of the Present Invention

FIG. 2 depicts components **20** used within a communications device to detect and process urgency conditions. The communications device includes a manipulable mechanism **24**, such as a roller (which is also known as a thumbwheel). A user performs a manipulation **22** of the manipulable mechanism **24** in order to communicate with a software application **34** that is operating on the device. A user may create an urgency condition when the user imparts a multiplicity of consecutive strokes onto the roller.

When the manipulable mechanism **24** is a roller, the larger part of the roller is typically embedded within the device with only a small section of the roller protruding from the case of the device. The user has access to this small portion of the circumference of the roller at any one time. In the invention this mechanical constraint is turned into a resource to be exploited by the invention in a novel fashion. Given that the user cannot clasp the roller on opposing sides, the user is limited to stroking the protruding portion of the roller with a finger, usually the thumb. It should be noted that the device may be any such data communications device, such as a pager or a device that is equipped to receive both voice and non-voice data messages (e.g., cellular phone).

Manipulation **22** of the mechanism **24** results in signals being generated that are indicative of the direction, amount and other characteristics of the manipulation **22**. An urgency activity detector module **26** uses such characteristics data **28** to detect and process an urgency activity/action. Upon detection, the urgency activity detector **26** generates a message that indicates whether an urgency activity has occurred. The message is placed in a queue **30** so that the software application **34** may retrieve and use it.

An enable/disable message **36** may be issued so that the communications device may turn on or off the urgency detection processing. If a disable message is issued, then the communications device operates in a manner consistent with a traditional method. In this manner, the present

invention is capable of improved application signalling, while remaining backwards compatible with existing applications and roller hardware.

FIG. 3 depicts steps used to process urgency activities within the communications device. Step **10** waits for roller activity to occur. This usually involves an interrupt service routine being triggered due to the rotation of the roller. At step **12** the roller position is incremented in the direction of the rotation of the roller, by a constant, which is proportional to the amount of roller rotation. Decision block **14** examines whether the communications device has been enabled to detect urgency activities. If it is not enabled, then step **16** places the roll message into the queue, which is accessible to the currently running application.

However, if the urgency roller acceleration detection mode is enabled, then the device performs the following processing. Decision block **50** examines whether a change in roll direction has occurred. If a roll direction change has occurred, then the present invention interprets this as signifying the user's intention for instantaneous acceleration in the opposite direction of rotation, or rapid deceleration. When this condition is detected, processing continues at step **56**. Step **56** resets the speed term before step **16** places the roll message in the queue. However, if a roll direction change has not occurred, then processing continues at decision block **52**.

Decision block **52** examines whether a low degree of urgency in a roller operation has occurred. Decision block **52** detects a low rotation urgency by examining the timeout since the last roll. FIG. 4 shows in greater detail how a timeout is detected since the last roll.

With reference to FIG. 4, step **110** samples the value of the device's real time clock as "rtc". At decision block **112,** the value of rtc is compared to the time value of the last roller rotation event, relative to a timeout threshold. In the event that the time lapsed between any two consecutive roll events is greater than the timeout threshold, a false timeout condition is signalled at step **114**. Conversely, if the time lapsed between any two consecutive roll events is less than the timeout threshold, a true timeout condition is signalled at

step **116**. Finally, the value of the real time clock is sampled as 'time' in step **118** for future use in determining whether a timeout has occurred since this roll. It was found experimentally that the value of 50 ms was adequate for the value of timeout threshold.

In the event that the invention has detected a low degree of rotation urgency, a zero speed accelerated rotation message is generated, which is equivalent to a non-accelerated message. With reference back to FIG. 3, this is accomplished at step **56** by resetting the speed term. The zero speed accelerated rotation message is placed in the queue at step **16**. After step **16** executes, then processing continues at step **10** which waits for roller activity.

If decision block **52** determines that a timeout has not occurred since the last roll, then processing continues at step **54**. Step **54** aims to detect a high rotation urgency by detecting a consecutive roll. As used in this description, the term "rotation urgency" is the inverse function of the time lapsed between two consecutive roller strokes, measured in Hertz. Using appropriate thresholds for the time lapse, it is possible to define rotation urgency according to various degrees. For example, high and low rotation urgency could have corresponding low and high time-lapse thresholds, respectively. FIG. 5 shows in greater detail how a consecutive roll is detected.

With reference to FIG. 5, step **210** samples the value of the real time clock as "rtc". At step **212,** the value of rtc is compared to the time value of the last roller rotation event, relative to a consecutive threshold. In the event that the time lapsed between any two consecutive roll events is greater than the consecutive threshold, a false consecutive roll condition is signalled at step **214.** Conversely, if the time lapsed between any two consecutive roll events is smaller than the consecutive threshold, a true consecutive roll condition is signalled at step **216**. Finally, the value of the real time clock is sampled as 'time' in step **218** for future use in determining whether the next roll is consecutive. It was found experimentally that the value of 350 ms was adequate for the value of consecutive threshold. Processing continues back at FIG. 3.

With reference to FIG. 3, in the event that the decision block **54** has detected a high degree of rotation urgency, an accelerated rotation message is generated. Step **58** increments the roller position by the speed term in the direction of the roll. Decision block **60** examines whether the speed term is at its limit. If it is at its limit, then step **16** places the roll message in the queue. However if the speed term has not yet reached its limit, then step **62** increases the speed term before step **16** places the roll message in the queue.

It should be noted that detecting high and low degrees of rotation urgency and generating accelerated rotation messages may have a combined effect of providing a form of electronic inertia during urgent rotation, whereby it appears to the user that a roller which has mechanically stopped rotating in between strokes continues to cause rotation signalling to occur in the form of accelerated rotation messages. These messages convey an upper bounded rotation amount that is proportional to rotation urgency. The term "electronic rotation inertia" is rotation signalling which continues to occur after the mechanical rotation which initially caused the signalling has stopped. Also, it should be noted that a further refinement is accomplished by providing a way of rapid rotation deceleration, which is another type of accelerated rotation message.

It will be appreciated that the above description relates to the preferred embodiment by way of example only. Many variations on the invention will be obvious to those knowledgeable in the field, and such obvious variations are within the scope of the invention as described and claimed, whether or not expressly described. For example, FIG. 6 depicts one such variation of the present invention.

FIG. 6 shows an exemplary use of the present invention on a handheld electronic communications device **300**. Manipulation **22** of roller **302** generates a roller input signal. The roller input signal includes a roller rotation direction which can be either positive or negative and a roller rotation amount. An accelerated mode input **36** is received which can be either active or inactive. When the mode is inactive, then present invention is disabled and the rotation

handler module **304** handles manipulation signals in accordance with traditional roller approaches.

Roller state is computed by the following steps. If the roller input rotation direction is positive, then the roller position stored in register **306** is incremented by a constant amount proportional to the roller rotation amount. If the roller input rotation direction is negative, then the roller position stored in the register **306** is decremented by a constant amount proportional to the roller rotation amount.

If the accelerated mode input is active, then the roller state data is stored in the following registers: the value of the roller rotation direction is stored in the direction register **308**; the value of a real time clock is stored in the time register **310**; and the instantaneous differential amount of roller acceleration is stored in the speed register **312**.

The roller rotation direction is compared to the value stored in the direction register **308**. If the roller rotation direction is different than the value stored in the direction register **308**, a change in roller direction condition is detected. If the change in roller direction condition is detected, then the speed register **312** is reset to zero. The lapsed time is computed by subtracting the value of the time register from the value of the real time clock. If the time lapsed is greater than a timeout threshold, a timeout condition is detected. If the timeout condition is detected, the speed register **312** is reset to zero. If the time lapsed is smaller than a consecutive threshold, a consecutive roll condition is detected.

If the consecutive roll condition is detected, then the following steps are performed. If the roller rotation direction is positive, then the roller position register **306** is incremented by the amount of the speed register **312**. If the roller rotation direction is negative, then the roller position register **306** is decremented by the amount of the speed register **312**. If the speed register **312** is less than a predetermined limit, then the value of the speed register **312** is incremented by an acceleration amount. The value of the roller rotation direction is stored in the direction register **308**. The value of the real time clock is stored in the time register **310**. The change in the roller state is placed as a roll message into the

queue **30**, which is accessible to the communications device system software **314** so that the message can be communicated to the currently running application **34**.